Preliminary Hydrology Study for 29610 Mac Tan Road

APN 188-191-28

Permit No.: TM 21002/ER 06-02-006

Valley Center, California
County of San Diego

PREPARED FOR:
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DATE:
January 11, 2007
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8-11-08

DOUGLAS E. LOGAN, RCE 39726 **DATE**

This Drainage Study has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

8-11-08

Douglas E. Logan
REGISTERED CIVIL ENGINEER

DATE

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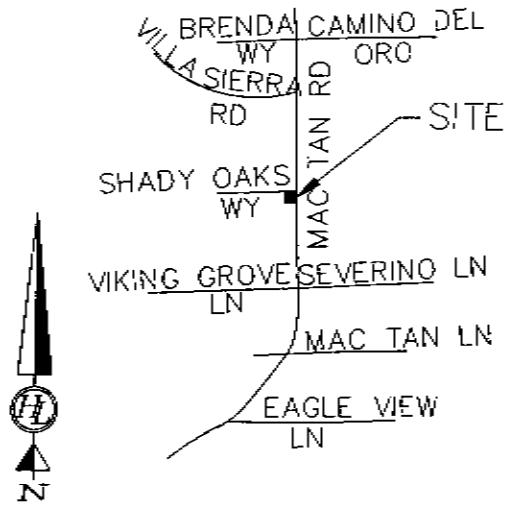
1.0 EXECUTIVE SUMMARY

1.1 Introduction

This Hydrology Study for 29610 Mac Tan Road has been prepared to analyze the hydrologic characteristics of the existing and proposed project site, and determine the existing condition offsite hydrologic characteristics that are conveyed through the proposed project site. This report intends to present the methodology and the calculations used for determining the runoff from the project site in both the pre-developed (existing) conditions and the post-developed (proposed) conditions, as well as the offsite areas, produced by the 100 year 6 hour storm. Additionally, this report intends to include hydraulic analysis of each existing natural drainage channel to delineate the limits of inundation from the 100-year 6 hour storm event.

1.2 Existing Conditions

The proposed project site is located off of the west side of Mac Tan Road, south of SR-76, north of Valley Center Road, east of Cole Grade Road, and west of Valley Center Road as shown on the vicinity map below:



VICINITY MAP

NOT TO SCALE

The existing site consists of a single family residential structure, located on a single parcel. Drainage from the existing site is primarily conveyed in a southerly direction across the project site. As this drainage is directed to the south, it is conveyed overland via one of two natural channels that cross the project site.

An existing 24-inch CMP culvert crosses Shady Oaks Way and discharges into the natural channel in Parcel 2. This culvert was constructed to convey stormwater from the property to the north of Parcel 2. A grated inlet collects runoff and is then conveyed through the 24-inch CMP.

Along the westerly side of Mac Tan Road an existing brow ditch collects and conveys surface water runoff from Mac Tan Road and conveys it in a southerly manner. The watershed basin for this brow ditch has an area of roughly 0.42 acres, of the 17.3 acre easterly watershed. This brow ditch is unimproved and has several points in which storm water it conveys will leave the brow ditch and flows into the natural channel to the west.

1.3 Proposed Project

The project site consists of a two parcel split with one parcel containing an existing single family residential home and the second parcel proposes grading for a future single family residence. No additional improvements are proposed on the existing single family residential home parcel at this time. Some undisturbed terrain covered with natural vegetation is proposed to remain.

The drainage of the proposed development will essentially maintain the same flow patterns as the existing condition. Earthen swales will be utilized to direct storm water on site safely away form the proposed structures. Storm water generated and conveyed across the proposed residential pad will be conveyed in earthen and BMP swales and will ultimately confluence with the natural channel to the west of the project site. The proposed residential lot design will also utilize a driveway accessing the proposed lot from the private road to the north, Shady Oaks Way. This proposed design will not impact drainage or road improvements in Mac Tan Road.

The intent of storm drain system design was to maintain the existing conditions to the maximum extent practicable.

1.4 Summary of Results

Hydrologic analysis of the pre-developed and post-developed conditions of the proposed project site is included in this report as section 3.1 and 3.2 respectively. The pre-developed and post-developed condition hydrologic model that was

developed to analyze the project site includes two points of analysis. Section 3.1 illustrates that the easterly watershed area is equal to 17.3 acres, has a time of concentration (Tc) equal to 16.45 minutes and has a peak discharge in the 100-year 6 hour storm event of 33.88 cfs; while the westerly watershed area is equal to 192.43 acres, has a time of concentration (Tc) equal to 27.35 minutes and has a peak discharge in the 100-year 6 hour storm event of 268.65 cfs. In the post-developed condition hydrologic analysis in section 3.2 illustrates that the easterly watershed area is equal to 17.3 acres, has a time of concentration (Tc) equal to 16.45 minutes and has a peak discharge in the 100-year 6 hour storm event of 34.07 cfs; while the westerly watershed area is equal to 192.43 acres, has a time of concentration (Tc) equal to 27.35 minutes and has a peak discharge in the 100-year 6 hour storm event of 268.65 cfs.

Additionally, hydraulic analysis of the two existing natural channels was prepared for the portion of the channel that cross the project site. Two channel cross sections were analyzed for each channel using the peak flows tributary to them. The hydraulic analysis of these channels was generated to delineate the limit of inundation for each channel. The output data from this analysis of the channels associated with the easterly and westerly basins are included in section 4.1 and 4.2 respectively.

1.5 Conclusions

The project site hydrologic models for both the pre- and post-developed conditions encompass a total area of 17.30 acres for the easterly basin and 192.43 acres for the westerly basin, and each condition consists of two separate sub-basins. Evaluating the two models, the proposed development will maintain the hydrologic and hydraulic characteristics of the westerly watershed identically to the existing conditions. However the hydrologic and hydraulic characteristics of the easterly watershed, associated with the proposed parcel 2 residential lot amount of runoff discharged from the project site, will be slightly impacted. The addition of the residential structure and driveway will create an increase in impervious surface and result in slightly more runoff being discharged form the project site as compared to the runoff from the site in the existing conditions. Due to the fact that the proposed design includes creating a graded flat pad suitable for construction of a residential structure, the flow path of stormwater generated on parcel 2 in the vicinity of the driveway or structure will be attenuated by the flat flowpath and the drainage improvements. However the hydrologic model for the proposed developed condition illustrates that an increase in the 100-year peak discharge as compared to the existing condition model of 0.19 cfs, an increase of only 0.56% from the existing condition peak flow, and therefore no significant impact to the downstream conditions is anticipated.

The proposed storm drain system incorporates the design of the grass-lined BMP swales located on the proposed parcel and will convey storm water over pervious

surfaces prior to reaching each respective point of discharge, along the southerly project boundary.

The proposed storm drain system will safely convey the entire 100-year peak flow generated by offsite and onsite runoff.

1.6 References

"San Diego County Hydrology Manual", revised June 2003, County of San Diego, Department of Public Works, Flood Control Section.

2.0 METHODOLOGY

2.1 Introduction

The hydrologic model used to perform the hydrologic analysis presented in this report utilizes the Ration Method (RM) equation, Q=CIA. The RM formula estimates the peak rate of runoff based on the variables of area, runoff coefficient, and rainfall intensity. The rainfall intensity (I) is equal to:

$$I = 7.44 \times P_6 \times D^{-0.645}$$

Where:

I = Intensity (in/hr)
P_6 = 6-hour precipitation (inches)
D = duration (minutes – use Tc)

Using the Time of Concentration (Tc), which is the time required for a given element of water that originates at the most remote point of the basin being analyzed to reach the point at which the runoff from the basin is being analyzed. The RM equation determines the storm water runoff rate (Q) for a given basin in terms of flow (typically in cubic feet per second (cfs) but sometimes as gallons per minute (gpm)). The RM equation is as follows:

$$Q = CIA$$

Where:

Q= flow (in cfs)
C = runoff coefficient, ratio of rainfall that produces storm water runoff (runoff vs. infiltration/evaporation/absorption/etc)
I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour.
A = drainage area contributing to the basin in acres.

The RM equation assumes that the storm event being analyzed delivers precipitation to the entire basin uniformly, and therefore the peak discharge rate will occur when a raindrop that falls at the most remote portion of the basin arrives at the point of analysis. The RM also assumes that the fraction of rainfall that becomes runoff or the runoff coefficient C is not affected by the storm intensity, I, or the precipitation zone number.

In addition to the above Ration Method assumptions, the conservative assumption that all runoff coefficients utilized for this report are based on type "D" soils. The 100-year 6-hour and 24-hour Rainfall isopluvials, showing the approximate project location, as well as the Soil Hydrologic Groups map are included at the end of this section.

2.2 County of San Diego Criteria

As defined by the County Hydrology Manual dated June 2003, the rational method is the preferred equation for determining the hydrologic characteristics of basins up to approximately one square mile in size. The County of San Diego has developed its own tables, nomographs, and methodologies for analyzing storm water runoff for areas within the county. The County has also developed precipitation isopluvial contour maps that show even lines of rainfall anticipated from a given storm event (i.e. 100-year, 6-hour storm).

One of the variables of the RM equation is the runoff coefficient, C. The runoff coefficient is dependent only upon land use and soil type and the County of San Diego has developed a table of Runoff Coefficients for Urban Areas to be applied to basin located within the County of San Diego. The table categorizes the land use, the associated development density (dwelling units per acre) and the percentage of impervious area. Each of the categories listed has an associated runoff coefficient, C, for each soil type class.

The County has also illustrated in detail the methodology for determining the time of concentration, in particular the initial time of concentration. The County has adopted the Federal Aviation Agency's (FAA) overland time of flow equation. This equation essentially limits the flow path length for the initial time of concentration to lengths of 100 feet or less, and is dependent on land use and slope.

2.3 Runoff Coefficient Determination

As stated in section 2.2, the runoff coefficient is dependent only upon land use and soil type and the County of San Diego has developed a table of Runoff Coefficients for Urban Areas to be applied to basin located within the County of San Diego. The table, included at the end of this section, categorizes the land use, the associated development density (dwelling units per acre) and the percentage of impervious area.

For the proposed development the total number of dwellings associated with the watersheds is 64, and the total watershed area is roughly equal to 209.73 acres. The developed portions of the project site were modeled with a dwelling unit per acre (DU/A) ratio of 0.31 and therefore the runoff coefficient of 0.41, which corresponds to DU/A of 1 or less and an impervious ration of 10%, was chosen.

For the existing conditions except for the area described in the hydrologic model between nodes 16 and 10, one coefficient was calculated. The total number of dwellings associated with the watersheds is 63, and the total watershed area is roughly equal to 209.73 acres. The existing condition analysis was modeled with a dwelling unit per acre (DU/A) ratio of 0.30. Therefore the runoff coefficient of

0.41, which corresponds to DU/A of 1.0 or less and an impervious ratio of 10%, was chosen.

Additionally a calculated coefficient, as described in the previous paragraph, was utilized to predict the hydrologic characteristics of the area associated with the proposed parcel 2. In the existing condition the watershed sub-basin associated with the lot includes impervious surfaces from Mac Tan Road and the private road Shay Oaks Way. Based on the impervious surface ratio comparison a runoff coefficient of 0.39 was calculated and used for the sub-basin watershed directly associated with the proposed parcel 2.

3.0 Hydrology Model Output

3.1 Pre-Developed Hydrologic Model Output

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          RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                        2003,1985,1981 HYDROLOGY MANUAL
       (c) Copyright 1982-2005 Advanced Engineering Software (aes)
           Ver. 2.0 Release Date: 06/01/2005  License ID 1574

                        Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* HYDROLOGIC ANALYSIS OF THE 100-YEAR 6-HOUR STORM EVENT FOR:              *
* TAM TPM -APN #188-191-28 - 29610 MAC TAN ROAD                            *
* PRE-DEVELOPED CONDITIONS                                                 *
 **************************************************************************

  FILE NAME: C:\AES\2007-71\100-EX2.DAT
  TIME/DATE OF STUDY: 13:02 06/22/2007
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.800
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+------------------------------------------------------------------------+
| BEGIN ANALYSIS OF EASTERLY BASIN                                       |
|                                                                        |
|                                                                        |
+------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE      14.00 TO NODE      13.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  82
```

```
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
   UPSTREAM ELEVATION(FEET) =   1842.00
   DOWNSTREAM ELEVATION(FEET) =   1834.00
   ELEVATION DIFFERENCE(FEET) =      8.00
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.210
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.705
   SUBAREA RUNOFF(CFS) =      0.29
   TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.29

 ****************************************************************************
   FLOW PROCESS FROM NODE      13.00 TO NODE     12.00 IS CODE =  52
 ----------------------------------------------------------------------------
   >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =   1834.00  DOWNSTREAM(FEET) =   1664.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =  2282.42   CHANNEL SLOPE =  0.0745
   NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
   CHANNEL FLOW THRU SUBAREA(CFS) =      0.29
   FLOW VELOCITY(FEET/SEC) =    4.09 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
   TRAVEL TIME(MIN.) =   9.29   Tc(MIN.) =  15.50
   LONGEST FLOWPATH FROM NODE     14.00 TO NODE     12.00 =  2382.42 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      13.00 TO NODE     12.00 IS CODE =  81
 ----------------------------------------------------------------------------
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.825
   RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
   SOIL CLASSIFICATION IS "D"
   S.C.S. CURVE NUMBER (AMC II) =  82
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
   SUBAREA AREA(ACRES) =   15.17   SUBAREA RUNOFF(CFS) =   30.01
   TOTAL AREA(ACRES) =     15.25   TOTAL RUNOFF(CFS) =   30.17
   TC(MIN.) =  15.50

 ****************************************************************************
   FLOW PROCESS FROM NODE      12.00 TO NODE     11.00 IS CODE =  31
 ----------------------------------------------------------------------------
   >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
   >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =  1661.00  DOWNSTREAM(FEET) =  1652.00
   FLOW LENGTH(FEET) =    54.57   MANNING'S N =  0.015
   DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.9 INCHES
   PIPE-FLOW VELOCITY(FEET/SEC.) =  22.32
   ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
   PIPE-FLOW(CFS) =     30.17
   PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =  15.54
   LONGEST FLOWPATH FROM NODE     14.00 TO NODE     11.00 =  2436.99 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      11.00 TO NODE     10.00 IS CODE =  52
 ----------------------------------------------------------------------------
   >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =   1652.00  DOWNSTREAM(FEET) =   1644.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   298.94   CHANNEL SLOPE =  0.0268
   CHANNEL FLOW THRU SUBAREA(CFS) =     30.17
   FLOW VELOCITY(FEET/SEC) =    5.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
   TRAVEL TIME(MIN.) =   0.91   Tc(MIN.) =  16.45
   LONGEST FLOWPATH FROM NODE     14.00 TO NODE     10.00 =  2735.93 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE      10.00 TO NODE     10.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
```

```
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =  16.45
  RAINFALL INTENSITY(INCH/HR) =   4.64
  TOTAL STREAM AREA(ACRES) =    15.25
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     30.17

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     15.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3900
  S.C.S. CURVE NUMBER (AMC II) =  82
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1665.00
  DOWNSTREAM ELEVATION(FEET) =   1656.60
  ELEVATION DIFFERENCE(FEET) =      8.40
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.287
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.637
  SUBAREA RUNOFF(CFS) =      0.98
  TOTAL AREA(ACRES) =      0.29   TOTAL RUNOFF(CFS) =      0.98

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     10.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1656.60  DOWNSTREAM(FEET) =   1644.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   280.82   CHANNEL SLOPE =  0.0449
  NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
  CHANNEL FLOW THRU SUBAREA(CFS) =      0.98
  FLOW VELOCITY(FEET/SEC) =   3.18 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   1.47   Tc(MIN.) =   7.76
  LONGEST FLOWPATH FROM NODE     16.00 TO NODE     10.00 =   380.82 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     10.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.540
  *USER SPECIFIED(SUBAREA):
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .3900
  S.C.S. CURVE NUMBER (AMC II) =  82
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.3900
  SUBAREA AREA(ACRES) =     1.76   SUBAREA RUNOFF(CFS) =     5.18
  TOTAL AREA(ACRES) =      2.05   TOTAL RUNOFF(CFS) =     6.03
  TC(MIN.) =   7.76

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   7.76
  RAINFALL INTENSITY(INCH/HR) =   7.54
  TOTAL STREAM AREA(ACRES) =     2.05
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      6.03

  ** CONFLUENCE DATA **
  STREAM      RUNOFF       Tc       INTENSITY       AREA
  NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1        30.17     16.45         4.644          15.25
     2         6.03      7.76         7.540           2.05

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
```

```
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF      Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)   (INCH/HOUR)
     1        20.26      7.76       7.540
     2        33.88     16.45       4.644

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     33.88   Tc(MIN.) =   16.45
 TOTAL AREA(ACRES) =     17.30
 LONGEST FLOWPATH FROM NODE     14.00 TO NODE     10.00 =  2735.93 FEET.

+----------------------------------------------------------------------------+
| END ANALYSIS OF EASTERLY BASIN                                             |
| BEGIN ANALYSIS OF WESTERLY BASIN                                           |
|                                                                            |
+----------------------------------------------------------------------------+

****************************************************************************
 FLOW PROCESS FROM NODE     23.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
 UPSTREAM ELEVATION(FEET) =   1962.00
 DOWNSTREAM ELEVATION(FEET) =   1955.00
 ELEVATION DIFFERENCE(FEET) =      7.00
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.493
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.459
 SUBAREA RUNOFF(CFS) =      2.25
 TOTAL AREA(ACRES) =      0.65   TOTAL RUNOFF(CFS) =      2.25

****************************************************************************
 FLOW PROCESS FROM NODE     22.00 TO NODE     21.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1955.00  DOWNSTREAN(FEET) =   1651.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  5166.46   CHANNEL SLOPE =  0.0588
 CHANNEL FLOW THRU SUBAREA(CFS) =      2.25
 FLOW VELOCITY(FEET/SEC) =   4.28 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =  20.11   Tc(MIN.) =  26.61
 LONGEST FLOWPATH FROM NODE     23.00 TO NODE     21.00 =  5266.46 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     22.00 TO NODE     21.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.406
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
 SUBAREA AREA(ACRES) =  188.78   SUBAREA RUNOFF(CFS) =  263.63
 TOTAL AREA(ACRES) =    189.43   TOTAL RUNOFF(CFS) =  264.54
 TC(MIN.) =  26.61

****************************************************************************
 FLOW PROCESS FROM NODE     21.00 TO NODE     20.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1642.00  DOWNSTREAM(FEET) =   1636.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   365.50   CHANNEL SLOPE =  0.0164
```

```
   CHANNEL FLOW THRU SUBAREA(CFS) =    264.54
   FLOW VELOCITY(FEET/SEC) =   8.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
   TRAVEL TIME(MIN.) =   0.74   Tc(MIN.) =  27.35
   LONGEST FLOWPATH FROM NODE     23.00 TO NODE     20.00 =  5631.96 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
   TIME OF CONCENTRATION(MIN.) =  27.35
   RAINFALL INTENSITY(INCH/HR) =   3.35
   TOTAL STREAM AREA(ACRES) =   189.43
   PEAK FLOW RATE(CFS) AT CONFLUENCE =    264.54

 ****************************************************************************
   FLOW PROCESS FROM NODE     25.00 TO NODE     24.00 IS CODE =  21
 ----------------------------------------------------------------------------
   >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 ============================================================================
   RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
   SOIL CLASSIFICATION IS "D"
   S.C.S. CURVE NUMBER (AMC II) =  82
   INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
   UPSTREAM ELEVATION(FEET) =   1659.00
   DOWNSTREAM ELEVATION(FEET) =   1651.70
   ELEVATION DIFFERENCE(FEET) =      7.30
   SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.403
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.536
   SUBAREA RUNOFF(CFS) =      1.61
   TOTAL AREA(ACRES) =      0.46   TOTAL RUNOFF(CFS) =      1.61

 ****************************************************************************
   FLOW PROCESS FROM NODE     24.00 TO NODE     20.00 IS CODE =  52
 ----------------------------------------------------------------------------
   >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
   >>>>>TRAVELTIME THRU SUBAREA<<<<<
 ============================================================================
   ELEVATION DATA: UPSTREAM(FEET) =   1651.70  DOWNSTREAM(FEET) =   1636.00
   CHANNEL LENGTH THRU SUBAREA(FEET) =   341.48   CHANNEL SLOPE =  0.0460
   CHANNEL FLOW THRU SUBAREA(CFS) =      1.61
   FLOW VELOCITY(FEET/SEC) =   3.53 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
   TRAVEL TIME(MIN.) =   1.61   Tc(MIN.) =   8.02
   LONGEST FLOWPATH FROM NODE     25.00 TO NODE     20.00 =   441.48 FEET.

 ****************************************************************************
   FLOW PROCESS FROM NODE     24.00 TO NODE     20.00 IS CODE =  81
 ----------------------------------------------------------------------------
   >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
 ============================================================================
    100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.385
   RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
   SOIL CLASSIFICATION IS "D"
   S.C.S. CURVE NUMBER (AMC II) =  82
   AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
   SUBAREA AREA(ACRES) =    2.54   SUBAREA RUNOFF(CFS) =    7.69
   TOTAL AREA(ACRES) =      3.00   TOTAL RUNOFF(CFS) =    9.08
   TC(MIN.) =   8.02

 ****************************************************************************
   FLOW PROCESS FROM NODE     20.00 TO NODE     20.00 IS CODE =   1
 ----------------------------------------------------------------------------
   >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
   >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
 ============================================================================
   TOTAL NUMBER OF STREAMS =  2
   CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
   TIME OF CONCENTRATION(MIN.) =   8.02
   RAINFALL INTENSITY(INCH/HR) =   7.38
```

```
 TOTAL STREAM AREA(ACRES) =      3.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.08

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
     1       264.54     27.35         3.346        189.43
     2         9.08      8.02         7.385          3.00

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
     1        86.62      8.02         7.385
     2       268.65     27.35         3.346

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =    268.65   Tc(MIN.) =   27.35
 TOTAL AREA(ACRES) =    192.43
 LONGEST FLOWPATH FROM NODE     23.00 TO NODE     20.00 =  5631.96 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =    192.43  TC(MIN.) =     27.35
 PEAK FLOW RATE(CFS)    =    268.65
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

3.2 Developed Condition Hydrologic Model Output

```
**************************************************************************

            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
            Reference: SAN DIEGO COUNTY FLOOD CONTROL DISTRICT
                         2003,1985,1981 HYDROLOGY MANUAL
          (c) Copyright 1982-2005 Advanced Engineering Software (aes)
              Ver. 2.0 Release Date: 06/01/2005  License ID 1574

                            Analysis prepared by:



 ************************** DESCRIPTION OF STUDY **************************
* HYDROLOGIC ANALYSIS OF THE 100-YEAR 6-HOUR STORM EVENT FOR:              *
* TAM TPM -APN #188-191-28 - 29610 MAC TAN ROAD                            *
* DEVELOPED CONDITIONS                                                     *
 **************************************************************************

  FILE NAME: C:\AES\2007-71\100-PR2.DAT
  TIME/DATE OF STUDY: 12:54 06/22/2007
--------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
--------------------------------------------------------------------------
  2003 SAN DIEGO MANUAL CRITERIA

  USER SPECIFIED STORM EVENT(YEAR) = 100.00
  6-HOUR DURATION PRECIPITATION (INCHES) =   3.800
  SPECIFIED MINIMUM PIPE SIZE(INCH) =   6.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  SAN DIEGO HYDROLOGY MANUAL "C"-VALUES USED FOR RATIONAL METHOD
  NOTE: USE MODIFIED RATIONAL METHOD PROCEDURES FOR CONFLUENCE ANALYSIS
  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ==================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*

+------------------------------------------------------------------------+
| BEGIN ANALYSIS OF EASTERLY BASIN                                       |
|                                                                        |
|                                                                        |
+------------------------------------------------------------------------+

**************************************************************************
  FLOW PROCESS FROM NODE     14.00 TO NODE     13.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
==========================================================================
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  82
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1842.00
  DOWNSTREAM ELEVATION(FEET) =   1834.00
  ELEVATION DIFFERENCE(FEET) =      8.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.210
```

```
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.705
 SUBAREA RUNOFF(CFS) =      0.29
 TOTAL AREA(ACRES) =      0.08   TOTAL RUNOFF(CFS) =      0.29

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     12.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1834.00  DOWNSTREAM(FEET) =   1664.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  2282.42   CHANNEL SLOPE =  0.0745
 NOTE: CHANNEL FLOW OF 1. CFS WAS ASSUMED IN VELOCITY ESTIMATION
 CHANNEL FLOW THRU SUBAREA(CFS) =      0.29
 FLOW VELOCITY(FEET/SEC) =   4.09 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   9.29   Tc(MIN.) =  15.50
 LONGEST FLOWPATH FROM NODE     14.00 TO NODE     12.00 =  2382.42 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     13.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  4.825
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
 SUBAREA AREA(ACRES) =   15.17   SUBAREA RUNOFF(CFS) =   30.01
 TOTAL AREA(ACRES) =     15.25   TOTAL RUNOFF(CFS) =   30.17
 TC(MIN.) =  15.50

****************************************************************************
 FLOW PROCESS FROM NODE     12.00 TO NODE     11.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1661.00  DOWNSTREAM(FEET) =  1652.00
 FLOW LENGTH(FEET) =    54.57   MANNING'S N =  0.015
 DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.9 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  22.32
 ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =     30.17
 PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =  15.54
 LONGEST FLOWPATH FROM NODE     14.00 TO NODE     11.00 =  2436.99 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     11.00 TO NODE     10.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1652.00  DOWNSTREAM(FEET) =   1644.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   298.94   CHANNEL SLOPE =  0.0268
 CHANNEL FLOW THRU SUBAREA(CFS) =     30.17
 FLOW VELOCITY(FEET/SEC) =   5.49 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   0.91   Tc(MIN.) =  16.45
 LONGEST FLOWPATH FROM NODE     14.00 TO NODE     10.00 =  2735.93 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE     10.00 TO NODE     10.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  16.45
 RAINFALL INTENSITY(INCH/HR) =   4.64
 TOTAL STREAM AREA(ACRES) =    15.25
 PEAK FLOW RATE(CFS) AT CONFLUENCE =     30.17
```

```
****************************************************************************
 FLOW PROCESS FROM NODE      16.00 TO NODE      15.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
 UPSTREAM ELEVATION(FEET) =   1665.00
 DOWNSTREAM ELEVATION(FEET) =   1656.60
 ELEVATION DIFFERENCE(FEET) =      8.40
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.110
 100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.797
 SUBAREA RUNOFF(CFS) =      1.05
 TOTAL AREA(ACRES) =      0.29   TOTAL RUNOFF(CFS) =      1.05

****************************************************************************
 FLOW PROCESS FROM NODE      15.00 TO NODE      10.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1656.60  DOWNSTREAM(FEET) =   1644.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   420.35   CHANNEL SLOPE =  0.0300
 CHANNEL FLOW THRU SUBAREA(CFS) =      1.05
 FLOW VELOCITY(FEET/SEC) =   2.62 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   2.67   Tc(MIN.) =   8.79
 LONGEST FLOWPATH FROM NODE      16.00 TO NODE      10.00 =   520.35 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      15.00 TO NODE      10.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  6.960
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
 SUBAREA AREA(ACRES) =     1.76   SUBAREA RUNOFF(CFS) =     5.02
 TOTAL AREA(ACRES) =      2.05   TOTAL RUNOFF(CFS) =     5.85
 TC(MIN.) =   8.79

****************************************************************************
 FLOW PROCESS FROM NODE      15.00 TO NODE      10.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   8.79
 RAINFALL INTENSITY(INCH/HR) =   6.96
 TOTAL STREAM AREA(ACRES) =     2.05
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      5.85

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
    1        30.17     16.45         4.644          15.25
    2         5.85      8.79         6.960           2.05

 RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
 CONFLUENCE FORMULA USED FOR  2 STREAMS.

 ** PEAK FLOW RATE TABLE **
 STREAM      RUNOFF       Tc       INTENSITY
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
    1        21.96      8.79         6.960
```

```
      2       34.07    16.45       4.644

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     34.07   Tc(MIN.) =   16.45
  TOTAL AREA(ACRES) =     17.30
  LONGEST FLOWPATH FROM NODE     14.00 TO NODE     10.00 =  2735.93 FEET.

+-----------------------------------------------------------------------+
| END ANALYSIS OF EASTERLY BASIN                                        |
| BEGIN ANALYSIS OF WESTERLY BASIN                                      |
|                                                                       |
+-----------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     23.00 TO NODE     22.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  82
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
  UPSTREAM ELEVATION(FEET) =   1962.00
  DOWNSTREAM ELEVATION(FEET) =   1955.00
  ELEVATION DIFFERENCE(FEET) =      7.00
  SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.493
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.459
  SUBAREA RUNOFF(CFS) =      2.25
  TOTAL AREA(ACRES) =      0.65   TOTAL RUNOFF(CFS) =      2.25

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     21.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1955.00  DOWNSTREAM(FEET) =   1651.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  5166.46   CHANNEL SLOPE =  0.0588
  CHANNEL FLOW THRU SUBAREA(CFS) =      2.25
  FLOW VELOCITY(FEET/SEC) =   4.28 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =  20.11   Tc(MIN.) =  26.61
  LONGEST FLOWPATH FROM NODE     23.00 TO NODE     21.00 =  5266.46 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     21.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
   100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  3.406
  RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
  SOIL CLASSIFICATION IS "D"
  S.C.S. CURVE NUMBER (AMC II) =  82
  AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
  SUBAREA AREA(ACRES) =  188.78   SUBAREA RUNOFF(CFS) =  263.63
  TOTAL AREA(ACRES) =    189.43   TOTAL RUNOFF(CFS) =  264.54
  TC(MIN.) =  26.61

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     20.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1642.00  DOWNSTREAM(FEET) =   1636.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   365.50   CHANNEL SLOPE =  0.0164
  CHANNEL FLOW THRU SUBAREA(CFS) =    264.54
  FLOW VELOCITY(FEET/SEC) =   8.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   0.74   Tc(MIN.) =  27.35
  LONGEST FLOWPATH FROM NODE     23.00 TO NODE     20.00 =  5631.96 FEET.

****************************************************************************
```

```
 FLOW PROCESS FROM NODE      20.00 TO NODE      20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =  27.35
 RAINFALL INTENSITY(INCH/HR) =   3.35
 TOTAL STREAM AREA(ACRES) =   189.43
 PEAK FLOW RATE(CFS) AT CONFLUENCE =    264.54

****************************************************************************
 FLOW PROCESS FROM NODE      25.00 TO NODE      24.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
============================================================================
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   100.00
 UPSTREAM ELEVATION(FEET) =   1659.00
 DOWNSTREAM ELEVATION(FEET) =   1651.70
 ELEVATION DIFFERENCE(FEET) =      7.30
 SUBAREA OVERLAND TIME OF FLOW(MIN.) =    6.403
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  8.536
 SUBAREA RUNOFF(CFS) =      1.61
 TOTAL AREA(ACRES) =      0.46   TOTAL RUNOFF(CFS) =      1.61

****************************************************************************
 FLOW PROCESS FROM NODE      24.00 TO NODE      20.00 IS CODE =  52
----------------------------------------------------------------------------
 >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1651.70  DOWNSTREAM(FEET) =   1636.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   341.48   CHANNEL SLOPE =  0.0460
 CHANNEL FLOW THRU SUBAREA(CFS) =      1.61
 FLOW VELOCITY(FEET/SEC) =   3.53 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
 TRAVEL TIME(MIN.) =   1.61   Tc(MIN.) =   8.02
 LONGEST FLOWPATH FROM NODE      25.00 TO NODE      20.00 =   441.48 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE      24.00 TO NODE      20.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  100 YEAR RAINFALL INTENSITY(INCH/HOUR) =  7.385
 RESIDENTIAL (1. DU/AC OR LESS) RUNOFF COEFFICIENT = .4100
 SOIL CLASSIFICATION IS "D"
 S.C.S. CURVE NUMBER (AMC II) =  82
 AREA-AVERAGE RUNOFF COEFFICIENT = 0.4100
 SUBAREA AREA(ACRES) =     2.54   SUBAREA RUNOFF(CFS) =     7.69
 TOTAL AREA(ACRES) =      3.00   TOTAL RUNOFF(CFS) =     9.08
 TC(MIN.) =   8.02

****************************************************************************
 FLOW PROCESS FROM NODE      20.00 TO NODE      20.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   8.02
 RAINFALL INTENSITY(INCH/HR) =   7.38
 TOTAL STREAM AREA(ACRES) =      3.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      9.08

 ** CONFLUENCE DATA **
 STREAM      RUNOFF       Tc       INTENSITY       AREA
 NUMBER       (CFS)     (MIN.)    (INCH/HOUR)     (ACRE)
```

```
      1       264.54     27.35         3.346         189.43
      2         9.08      8.02         7.385           3.00

   RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
   CONFLUENCE FORMULA USED FOR  2 STREAMS.

   ** PEAK FLOW RATE TABLE **
   STREAM      RUNOFF       Tc       INTENSITY
   NUMBER       (CFS)     (MIN.)    (INCH/HOUR)
      1         86.62      8.02         7.385
      2        268.65     27.35         3.346

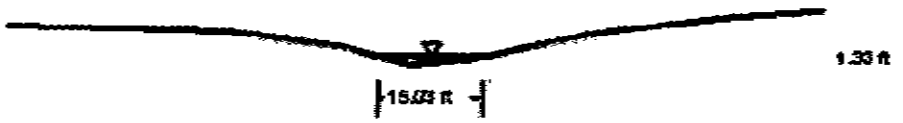
   COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
   PEAK FLOW RATE(CFS) =    268.65   Tc(MIN.) =   27.35
   TOTAL AREA(ACRES) =    192.43
   LONGEST FLOWPATH FROM NODE     23.00 TO NODE     20.00 =  5631.96 FEET.
 ============================================================================
   END OF STUDY SUMMARY:
   TOTAL AREA(ACRES)      =     192.43  TC(MIN.) =     27.35
   PEAK FLOW RATE(CFS)    =     268.65
 ============================================================================
 ============================================================================
   END OF RATIONAL METHOD ANALYSIS
```

4.0 Hydrology Model Output

4.1 Hydraulic Analysis of Easterly Natural Channel

Easterly Basin - Upstream Cross Section
Cross Section for Irregular Section - easterly 1

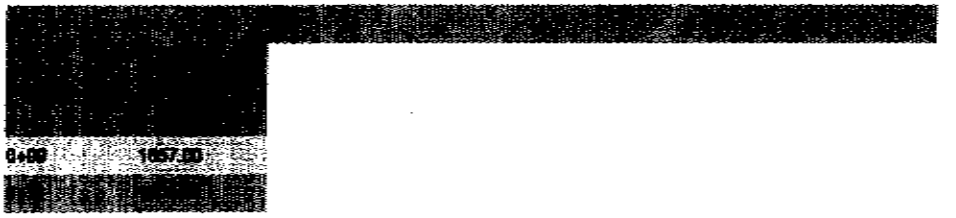
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Roughness Coefficient:	0.050	
Channel Slope:	0.01400	ft/ft
Normal Depth:	1.33	ft
Elevation Range:	1651.20 to 1659.00 ft	
Discharge:	32.62	ft³/s



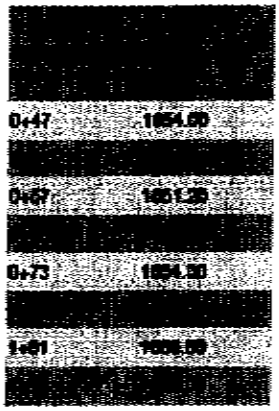
V: 1
ft 1

Worksheet for Irregular Section - easterly 1

Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Channel Slope:	0.01400	ft/ft
Discharge:	32.62	ft³/s
Current Roughness Weighted Meth:	ImprovedLotters	
Open Channel Weighted Roughnes:	ImprovedLotters	
Closed Channel Weighted Roughne	Horton	
Roughness Coefficient:	0.050	
Water Surface Elevation:	1652.53	ft
Elevation Range:	1651.20 to 1659.00 ft	
Flow Area:	11.34	ft²
Wetted Perimeter:	15.33	ft
Top Width:	15.03	ft
Normal Depth:	1.33	ft
Critical Depth:	1.06	ft
Critical Slope:	0.04465	ft/ft
Velocity:	2.88	ft/s
Velocity Head:	0.13	ft
Specific Energy:	1.46	ft
Froude Number:	0.58	
Flow Type:	Subcritical	



Worksheet for Irregular Section - easterly 1



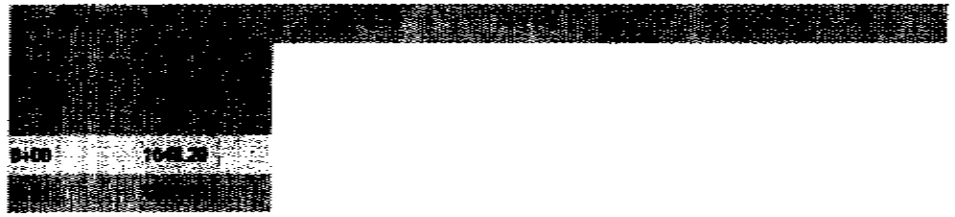
Easterly Basin - Downstream Cross Section
Cross Section for Irregular Section - EAST 2

Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Roughness Coefficient:	0.050	
Channel Slope:	0.01400	ft/ft
Normal Depth:	1.43	ft
Elevation Range:	1641.00 to 1648.40 ft	
Discharge:	32.62	ft³/s

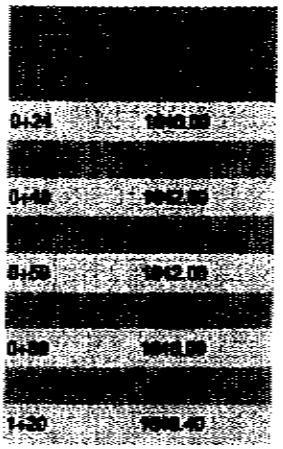
V: 1
H: 1

Worksheet for Irregular Section - EAST 2

Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Channel Slope:	0.01400	ft/ft
Discharge:	32.62	ft³/s
Current Roughness Weighted Meth	ImprovedLotters	
Open Channel Weighted Roughnes	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	
Roughness Coefficient:	0.050	
Water Surface Elevation:	1642.43	ft
Elevation Range:	1641.00 to 1648.40 ft	
Flow Area:	11.94	ft²
Wetted Perimeter:	17.45	ft
Top Width:	17.21	ft
Normal Depth:	1.43	ft
Critical Depth:	1.15	ft
Critical Slope:	0.04489	ft/ft
Velocity:	2.73	ft/s
Velocity Head:	0.12	ft
Specific Energy:	1.55	ft
Froude Number:	0.58	
Flow Type:	Subcritical	



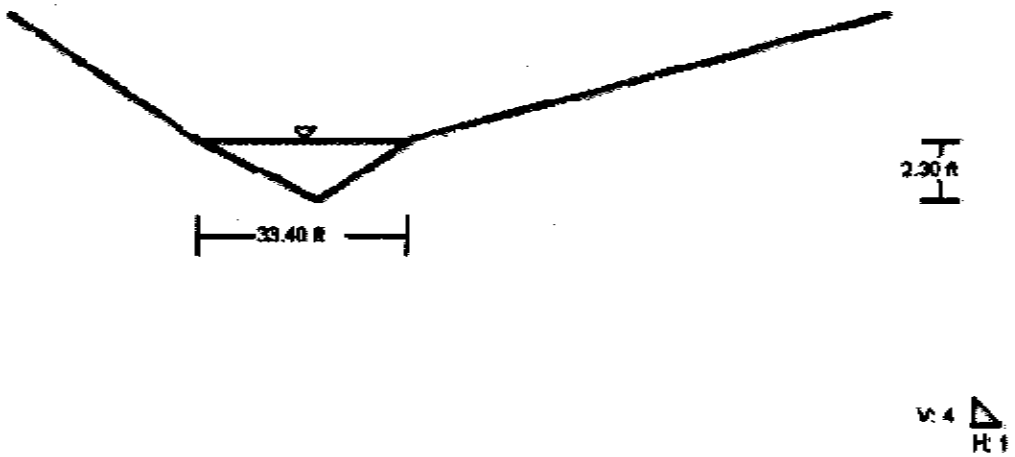
Worksheet for Irregular Section - EAST 2



4.2 Hydraulic Analysis of Westerly Natural Channel

Westerly Channel - Section 1
Cross Section for Irregular Section - WEST 1

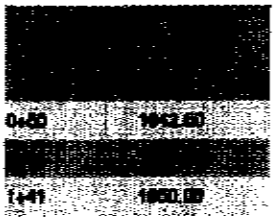
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Roughness Coefficient:	0.030	
Channel Slope:	0.01640	ft/ft
Normal Depth:	2.30	ft
Elevation Range:	1642.50 to 1650.00 ft	
Discharge:	266.41	ft³/s



Worksheet for Irregular Section - WEST 1

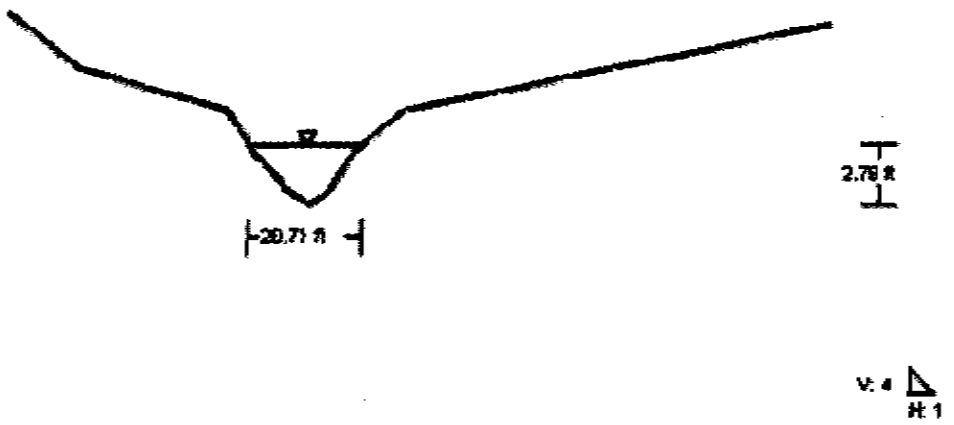
Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Channel Slope:	0.01640	ft/ft
Discharge:	266.41	ft³/s
Current Roughness Weighted Meth	ImprovedLotters	
Open Channel Weighted Roughnes	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	
Roughness Coefficient:	0.030	
Water Surface Elevation:	1644.80	ft
Elevation Range:	1642.50 to 1650.00 ft	
Flow Area:	38.47	ft²
Wetted Perimeter:	33.72	ft
Top Width:	33.40	ft
Normal Depth:	2.30	ft
Critical Depth:	2.43	ft
Critical Slope:	0.01246	ft/ft
Velocity:	6.93	ft/s
Velocity Head:	0.75	ft
Specific Energy:	3.05	ft
Froude Number:	1.14	
Flow Type:	Supercritical	

Worksheet for Irregular Section - WEST 1



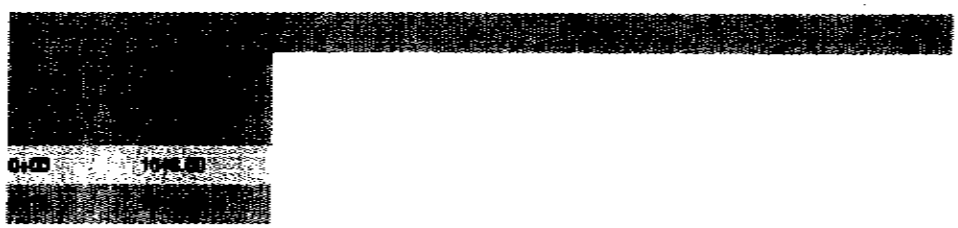
Westerly Channel - Section 2
Cross Section for Irregular Section - WEST 2

Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Roughness Coefficient:	0.030	
Channel Slope:	0.01640	ft/ft
Normal Depth:	2.79	ft
Elevation Range:	1639.60 to 1648.60 ft	
Discharge:	268.65	ft³/s



Worksheet for Irregular Section - WEST 2

Flow Element:	Irregular Section	
Friction Method:	Manning Formula	
Solve For:	Normal Depth	
Channel Slope:	0.01640	ft/ft
Discharge:	268.65	ft³/s
Current Roughness Weighted Meth	ImprovedLotters	
Open Channel Weighted Roughnes	ImprovedLotters	
Closed Channel Weighted Roughne	Hortons	
Roughness Coefficient:	0.030	
Water Surface Elevation:	1642.39	ft
Elevation Range:	1639.60 to 1648.60 ft	
Flow Area:	32.32	ft²
Wetted Perimeter:	21.54	ft
Top Width:	20.71	ft
Normal Depth:	2.79	ft
Critical Depth:	3.00	ft
Critical Slope:	0.01168	ft/ft
Velocity:	8.31	ft/s
Velocity Head:	1.07	ft
Specific Energy:	3.86	ft
Froude Number:	1.17	
Flow Type:	Supercritical	



Worksheet for Irregular Section - WEST 2